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The Road to Real-time Frequency Spectrum Sharing

By Thomas Kidd - [October-December 2014](#)

Simply stated, frequency management is the process of acquiring authority to operate a particular device at a location on a frequency under specific technical parameters, while spectrum sharing is a complex process intended to assure the best possible use of electromagnetic spectrum. There are many ways to share spectrum, and continually emerging technology will enable even greater sharing. What is limiting the implementation of these technologies is our century-old frequency management process designed to permanently assign one frequency to one system at one location for one use.

A frequency license grants holders certain rights critical to their business or operational plan. Whether air traffic control or emergency communications, the license holder is assured protection from harmful interference.

Improving the Frequency Management Process

The focus of this article is how to maintain protections assured by a traditional frequency license, while sharing the frequency spectrum among multiple users in real-time.

In 2014, acquiring a frequency assignment— the federal equivalent to a frequency license —took approximately 10,000,000 seconds (more than three months). We will use this as our baseline for improvements marking the milestones along the road to real-time spectrum sharing. While there is no true “real-time” technology, for the purposes of our journey we will set a goal of sub-second frequency management as near enough to real-time as would be needed for real-time electromagnetic spectrum sharing. Along our journey, we will discuss how frequency management will migrate from a people-centric manual process to a trusted autonomous capability.

Improving any process is a challenge. Reducing a process time as many as seven orders of magnitude, from 10,000,000 seconds to one second, is unobtainable in any traditional process improvement methodology. The longest journey begins with the first step. The journey to real-time spectrum sharing will take many steps and pass several critical milestones. To reach our goal, we will make improvements one step at a time, five steps in all. Because frequency management is a process, our journey will be made through a series of process improvements. Each step in reducing processing time signifies one or two orders of magnitude of improvement.

Spectrum Sharing Milestones

The first milestone process improvement is achievable through aggressively streamlining current information workflows. Where current frequency management processes require three months to replace one frequency with another, by 2021 this process will be reduced to three days. Spectrum managers will rely on automated tools to reduce validation steps and minimize rework. Subject matter expert coordination will be initiated through an automated review of license requests. Most licenses will be issued without any intermediate reviews or intervention.

The second major milestone for real-time spectrum sharing is in 2029, with the reduction of frequency processing time from three days to just three hours. While this is not yet real-time, a three-hour spectrum sharing timeframe will enable systems to share spectrum based on usage trends throughout the day. Changing frequencies several times per day will require greater reliance on machine-to-machine communications with only the most exceptional coordination requiring subject matter expert intervention. Most licenses will be requested and issued without any human intervention.

Total process automation, our third milestone, will be reached in 2037 when the typical frequency assignment processing time is reduced from three hours to three minutes. Systems will continually self-evaluate their spectrum requirements. Based on their anticipated frequency usage, they will request new frequencies and release old frequencies to satisfy near-term spectrum usage requirements. Localized frequency sharing will contribute to reduce process time by reducing reliance on centralized licensing. In individual systems, licenses will be granted and maintained from a centralized system based on local analysis.

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Passing the fourth milestone in 2043— reducing the process timeline from three minutes to three seconds — will mark the majority of frequency assignment processes shifting from centralized to decentralized licensing. Local frequency management systems will issue licenses based on mutually accepted rules for protection criteria. Incidents of harmful interference will be exceptionally rare as systems will continually evaluate and anticipate frequency requirements and acquire frequency licenses on demand.

Following this path, the fifth milestone and final destination of real-time spectrum sharing will be reached around 2050. Systems will retain full-licensed rights to their frequency assignment when required, and release all rights from the frequency assignment when no longer required. For practical purposes, when frequency assignments are traded in and out of systems in less than one second, licensed radio frequency spectrum will have become a real-time shared resource.

On the Horizon

This article did not address technological milestones because most readers will note regulatory processes inevitably lag behind technological innovation. Technology to implement real-time spectrum sharing exists in 2014— or is on horizon. This article considered what changes will take place to frequency management processes that will provide these systems near real-time access to spectrum on demand, while maintaining their current licensed spectrum rights and protections.

To some readers, our journey from traditional frequency management to real-time spectrum sharing has taken far too long, more than 35 years. Other readers will note that every one of the five major milestones along the way is a heroic effort in its own right, each reducing process timelines by 90 or 99 percent. All readers should recognize that real-time spectrum sharing will be the result of extraordinary changes in modern frequency management processes.

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